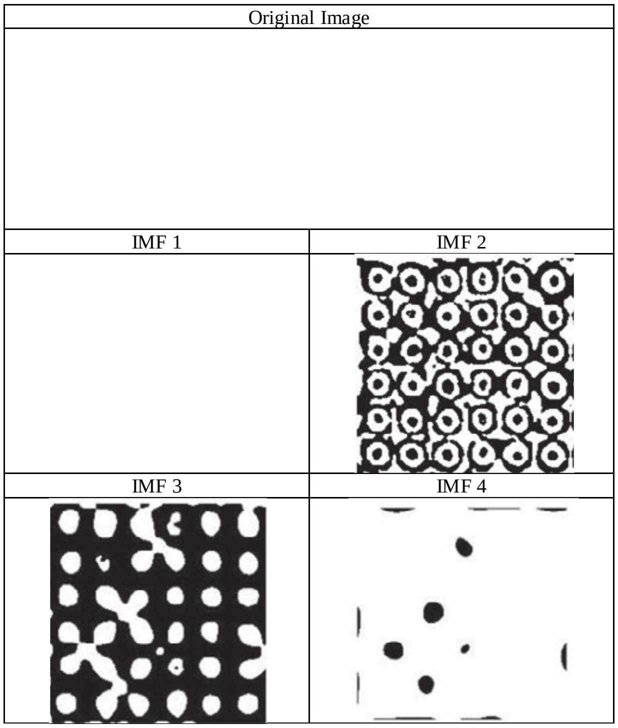

Fig 1: IMF of Microarray Image

$$p(r_k) = \frac{n_k}{N} k = 0,1,2,\ldots\ldots,L-1 \quad (3)$$

Calculate the cumulative distribution function (CDF)

$$C(r_k) = \sum_{i=0}^{k} p(r_k) \; k = 0,1,2,\ldots,L-1 \text{ and } o \le C(r_k) \le 1 \quad (4)$$

Where $n_k$is the no of pixels in the image having gray level $r_k$and rk is the $k^{th}$ gray level in the image.To improve the contrast enhancement of microarray image we going for Bi Histogram Equalization to be considered. It will find out the average gray level pixels in histogram of the microarray image[11] and then sub divides the histogram in to two segments based on the pixels. Later on Bi histogram equalization operation is applied to each segment.

The average of gray levels of the histogram is computed as

$$L_1 = \sum_{k=0}^{L-1} p(r_k) * (r_k) \quad (5)$$

Later on apply Window based Bi-Dimensional Empirical Mode Decomposition to the processed image to get the first IMF. We can determine a suitable threshold to convert the gray level values of the IMF image into black and white image such that the edge microarray image can be extracted. The processed edge image has the thick edge lines and some interior isolated pixels. Then mathematical morphology is applied to remove isolated pixels in the image. The final spot edge microarray image is obtained.

The main steps of the Spot Edge Detection using WBEMD are summed up as follows:

1. To obtain the sharper contrast of a microarray image, we are processing image with Bi Histogram Equalization.
2. Then from obtained image apply WBEMD to get the first IMF.
3. To obtain the gray level values of the First IMF we have to choose suitable thresholds values $T_1$ and $T_2$, which are helpful to convert the IMF image in to black and white image

$$I(x,y) = \left\{ \begin{matrix} o, T_1 \le IMF(x,y) \le T_2 \\ 1, \qquad else \end{matrix} \right\} (6)$$

4. The processed Edge image has thick edge lines and isolated pixels.
5. Perform Mathematical Morphology operations on the resulting image to remove isolated pixels
6. Now we can obtain the ultimate spot edge image.

## IV. EXPERIMENTAL RESULTS

The proposed method is used to detect the edge of cDNA microarray image. Processing of a cDNA microarray image performed on a sample microarray slide that has 48 blocks, each block consisting of 110 spots. A sample chosen block has 36 spots of the block have been cropped for simplicity. The sample image is a 198*196 pixel image that consists of a total of 38808 pixels. The microarray image is decomposed by traditional EMD decomposition has the above mentioned defect, because the high-frequency components and the low-frequency components can't be effectively separated each other. WEMD can effectively deal with the problem. The spot edge detection results of microarray image are presented in figure 2and the following figure shows the speed of various EMD methods. Suitable thresholds of pixel values -75 and -42 were determined through WBEMD, to convert into black and white image.

TABLE I: COMPARING THE OPERATION SPEED OF THE VARIOUS EMD METHODS

| **METHOD** | **BIEMD** | **MTEMD** | **DEMD** | **WBEMD** |
|---|---|---|---|---|
| Time(Seconds) | 62.639865 | 16.589472 | 29.674407 | 0.286590 |

## V. CONCLUSION

In this Article, we presented an new edge detection of cDNA Microarray images using WBEMD. The WBEMD approach can separate the spots from the background and it will generate accurate information about the spots such as pixel number and decreases the probability of errors encountered. The microarray edge information obtained by using WBEMD is s better than Sobel and Prewitt operators. Experiments prove that our approach is efficient and involves how to optimize the edges.

## REFERENCES

[1] M.Schena, D.Shalon, Ronald W.davis and Patrick O.Brown,"Quantitative Monitoring of gene expression patterns with a complementary DNA microarray", Science, 270,199,pp:467-470.

[2] Wei-Bang Chen, Chengcui Zhang and Wen-Lin Liu, "An Automated Gridding and Segmentation method for cDNAMicroarray Image Analysis", 19th IEEE Symposium on Computer-Based Medical Systems.

[3] Tsung-Han Tsai Chein-Po Yang, Wei-ChiTsai, Pin-Hua Chen, "Error Reduction on Automatic Segmentation in MicroarrayImage", IEEE 2007.

[4] EleniZacharia and DimitirsMaroulis, "Microarray Image Analysis based on an Evolutionary Approach" 2008 IEEE.

[5] N.E.Huang, Z.Shen, S.R.Long, "The empirical mode decomposition and the Hilbert Spectrum for non-linear and nonstationarytime series analysis". Proc. Roy. Soc, London.A, Vol.454, pp.903-995, 1998.

[6] Ali Ziaei, HojatollahYeganeh, KarimFaez, SamanSargolzaei, "A Novel Approach for Contrast Enhancement in Biomedical Images Based on Histogram Equalization", 2008 International Conference on BioMedical Engineering andInformatics.

[7] Jin Hyuk Kim, HyeYouns Kim and Yong Sung Lee, " A novel method using edge detection for signal extraction fromcDNA microarray image analysis", Experimental and Molecular Medicine, Vol 33, No.2, 83-88, June 2001.

[8] Sharif M. A. Bhuiyan, Reza R. Adhami, Jesmin F. Khan,"Aurora Image Denoising with a Modified BidimensionalEmpirical Mode Decomposition Method," *Proc. of IEEESoutheastCon 2008*, pp. 527-532, 2008.

[9] S.Anand, N.M.MarySindhuja," Spot Edge Detecton in Microarray Images Using Balanced GHM Multiwavelet",International Conference on Control, Automation, Communication and Energy Conservation, 2009 IEEE.

[10] James Z. Zhang "Edge Detection Using Fast Bi-dimensional Empirical Mode Decomposition and Mathematical Morphology" in 978-1-4244-5853-0/10/$26.00 ©2010 IEEE

[11] Yao Pei, Yangang Wu, DachengJiaImage Denoising based on Bidimensional Empirical Mode Decomposition in 2011 International Conference on Mechatronic Science, Electric Engineering and ComputerAugust 19-22, 2011 IEEE.

[12] Zheng Ling Adaptive Multi-Scale Edge Detection in the EMD Domain in 2012 Fourth International Conference on Computational and Information Sciences 978-0-7695-4789-3/12 $26.00 © 2012 IEEE

[13] J.Harikiran spot Edge Detection in Microarray Images using Bi-Dimensional Empirical Mode Decomposition science Direct volume 4,2012,pages 227-231.c3it-2012